



# Cambridge International AS & A Level

CANDIDATE  
NAME

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NUMBER

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**PHYSICS**

**9702/33**

Paper 3 Advanced Practical Skills 1

**October/November 2021**

**2 hours**

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

## INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
<b>Total</b>	

This document has **12** pages. Any blank pages are indicated.



You may not need to use all of the materials provided.

1 In this experiment, you will investigate combinations of resistors in an electrical circuit.

(a) Fig. 1.1. shows an electrical circuit.

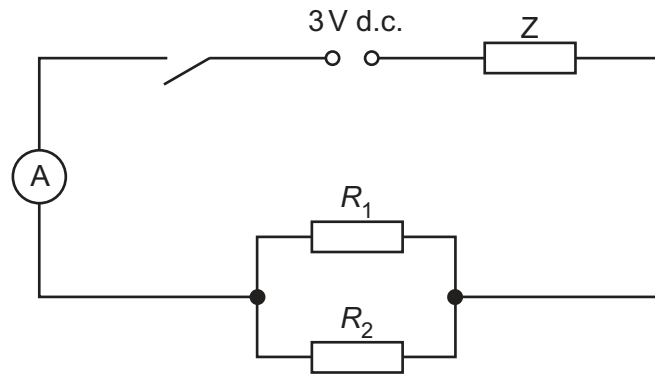


Fig. 1.1

- Set up the circuit shown in Fig. 1.1 using  $R_1 = 33\ \Omega$  and  $R_2 = 82\ \Omega$ .
- Calculate  $\frac{R_1 R_2}{(R_1 + R_2)}$ .

$$\frac{R_1 R_2}{(R_1 + R_2)} = \dots\dots\dots \Omega$$

- Close the switch.
- Record the ammeter reading  $I$ .

$$I = \dots\dots\dots$$

- Open the switch.

[1]

- (b) Use six different pairs of resistors to provide six different values of  $\frac{R_1 R_2}{(R_1 + R_2)}$ .

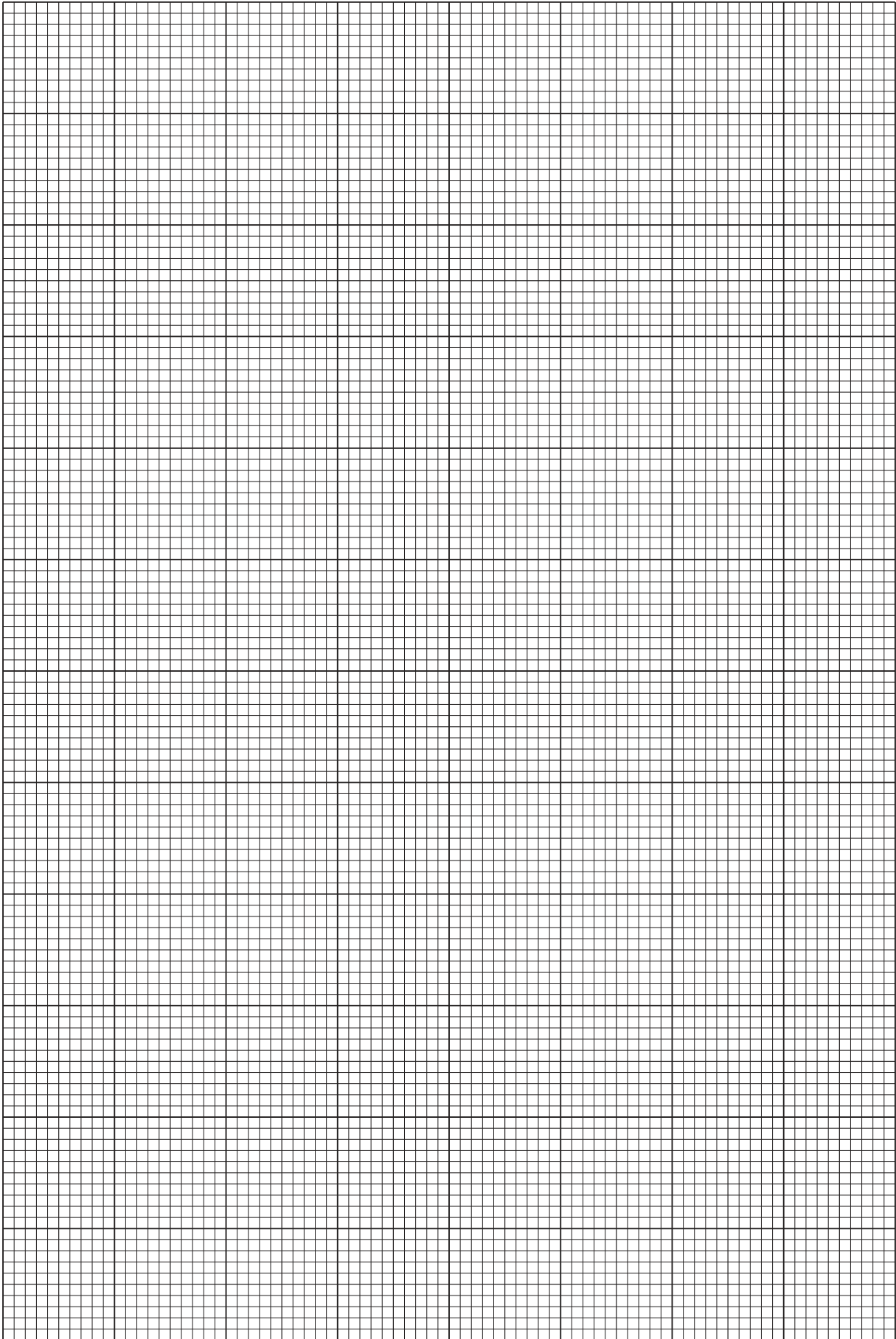
For each arrangement, record  $R_1$ ,  $R_2$  and  $I$  in a table. Include values of  $\frac{R_1 R_2}{(R_1 + R_2)}$  and  $\frac{1}{I}$  in your table.

- (c) (i) Plot a graph of  $\frac{1}{I}$  on the y-axis against  $\frac{R_1 R_2}{(R_1 + R_2)}$  on the x-axis. [10]
- (ii) Draw the straight line of best fit. [3]
- (iii) Determine the gradient and y-intercept of this line. [1]

gradient = .....

y-intercept = .....

[2]



- (d) (i) It is suggested that the quantities  $I$  and  $\frac{R_1 R_2}{(R_1 + R_2)}$  are related by the equation

$$\frac{1}{I} = P \left[ \frac{R_1 R_2}{(R_1 + R_2)} \right] + Q$$

where  $P$  and  $Q$  are constants.

Using your answers to (c)(iii), determine the values of  $P$  and  $Q$ .  
Give appropriate units.

$$P = \dots\dots\dots$$

$$Q = \dots\dots\dots [2]$$

- (ii) The constants  $P$  and  $Q$  are related to the electromotive force (e.m.f.)  $E$  of the power supply and the resistance  $Z$  of resistor  $Z$  by

$$P = \frac{1}{E} \text{ and } Q = \frac{Z}{E}.$$

Determine the values of  $E$  and  $Z$ .  
Give appropriate units.

$$E = \dots\dots\dots$$

$$Z = \dots\dots\dots [1]$$

[Total: 20]

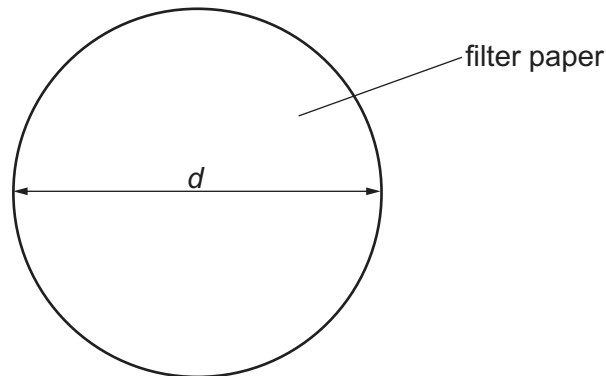
**You may not need to use all of the materials provided.**

**2** In this experiment, you will investigate the time taken for filter papers to fall in air.

**(a) (i)** • You have been provided with filter papers of two different sizes.

Take one sheet of the **smaller** filter paper.

• The diameter of one sheet of filter paper is  $d$ , as shown in Fig. 2.1.



**Fig. 2.1**

Measure and record  $d$ .

$d = \dots\dots\dots$  cm [2]

**(ii)** Calculate the area  $A$  of the filter paper using

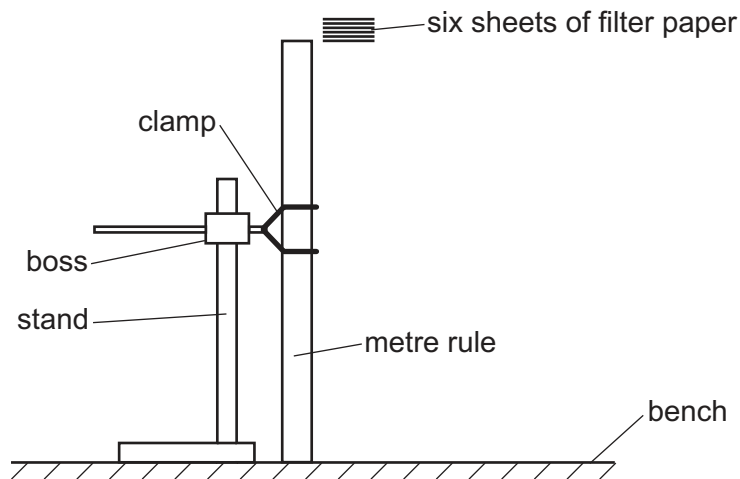
$$A = \frac{\pi d^2}{4}.$$

$A = \dots\dots\dots$  cm<sup>2</sup> [1]

**(iii)** Justify the number of significant figures that you have given for your value of  $A$ .

.....  
 .....  
 ..... [1]

- (b) (i) • Set up the apparatus as shown in Fig. 2.2.



**Fig. 2.2**

- Hold the six sheets of the smaller filter paper at the top of the metre rule, as shown in Fig. 2.2.
- Release the filter papers and start the stop-watch.
- The time between release and the filter papers hitting the bench is  $t$ .  
Measure and record  $t$ .

$t = \dots\dots\dots$  s [2]

- (ii) Estimate the percentage uncertainty in  $t$ . Show your working.

percentage uncertainty =  $\dots\dots\dots$  [1]

- (iii) Measure and record the total mass  $m$  of the sheets of smaller filter paper.

$m = \dots\dots\dots$  [1]



(c) (i) Repeat (a)(i) and (a)(ii) using one of the **larger** sheets of filter paper.

$$d = \dots\dots\dots \text{ cm}$$

$$A = \dots\dots\dots \text{ cm}^2$$

[1]

(ii) Using two sheets of the larger filter paper, repeat (b)(i) and (b)(iii).

$$t = \dots\dots\dots \text{ s}$$

$$m = \dots\dots\dots$$

[1]

(d) It is suggested that the relationship between  $t$ ,  $m$  and  $A$  is

$$kt = mA$$

where  $k$  is a constant.

(i) Using your data, calculate two values of  $k$ .

first value of  $k = \dots\dots\dots$

second value of  $k = \dots\dots\dots$

[1]

(ii) Explain whether your results support the suggested relationship.

.....  
.....  
.....  
..... [1]

(e) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

- 1. ....  
.....
- 2. ....  
.....
- 3. ....  
.....
- 4. ....  
.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

- 1. ....  
.....
- 2. ....  
.....
- 3. ....  
.....
- 4. ....  
.....

[4]

[Total: 20]

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